L 27228-66

ACC NR: AM6003227

0

Section 4. Properties and Use of Rhenium Alloys

L 27228-66

ACC NR: AM6003227

SUB CODE: 11/ SUBM DATE: 12Aug65/ ORIG REF: 381/ OTH REF: 360

Card 5/5 CC

SAVITSKIY, Ye.M.; TYLKINA, M.A.

Recrystallization of high-melting point titanium, hafnium, tantalum, rhenium, tungsten metals and their alloys. Issl.po zharopr.splav. 4:218-225 '59. (MIRA 13:5)
(Nonferrous metals--Thermal properties)
(Crystallization)

TYLKINA, L. G.

PA 20T35

USSR/Medicine - Plant Physiology Jan 1947
Medicine - Cucumbers

"Physiological Knowledge of the Effect of Gases on Sexuality in Growth," E. G. Minina, L. G. Tylkina, 4 pp

"Dok Ak Nauk SSSR" Vol LV, No 2

Presented by A. A. Rikhter 3 Aug 1946. Experiments were carried out on cucumbers. On the basis of Mevus experiments, the process of sexualization cannot be explained other than a closed chain of chemical reactions in the oxidization-reduction system of the plant.

20T35

DYUBUA, B.Ch.; PEKAREV, A.I.; POPOV, B.N.; TYLKINA, M.A.

Thermionic emission of tungsten alloys, titanium, and hafnium and its dependence on the pressure of oxygen. Radiotekh. i elektron. 7 no.9:1566-1573 S '62. (MIRA 15:9)
(Thermionic emission) (Tungsten-titanium-hafnium alloys)

1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

Forging of phosphoreted copper. M. A. Tylkina. *Vest. nik Metallofrom.* 19, No. 8, 85-6(1939).—The Cu alloy contained 0.8% P. The Cu should be kept for 1.5-2 min. at 500-600° before being passed through the forging machine. Higher temps. softened the alloy and increased its plasticity and caused the rods to sag and twist during the forging. Temps lower than 450° resulted in high brittleness. The rods were forged from 9.5 to 4.4 mm. in 6 stages. Hardness was measured on a Rockwell app. with a steel ball under a load of 100 kg. No relationship was observed

1 between the hardness and the pressure during forging. The hardness of the forged rods ranged from 70 to 85 units compared to 50-60 units for cast rods. B. Z. Kamich

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

Ca

9

Mechanical properties of alloys of the system aluminum magnesium. E. M. Savitskii and M. A. Tylkina. *Doklady Akad. Nauk S.S.S.R.* 63, 49-52(1948). At room temp., alloys in the region from 35 to 60 wt. % Mg, corresponding to the intermetallic phases β and γ, are brittle and have a high Brinell hardness H = 170 kg./sq. mm. However, plasticity increases above 200°, and individual differences between β and γ begin to appear above 300°. Softening with rising temp. is particularly pronounced in the heterogeneous region between β and γ; alloys with 38.9-41.3% Mg have, at 430°, H about 1/4 of the γ phase at the same temp. It may indicate a new phase, distinct from β', the upper temp. limit of which lies at 370°. Examples of data at 400° are: Al, solid soln. with 5% Mg, β-phase, alloy with 38.9% Mg, γ-phase, eutectic ($\gamma + \delta$), solid soln. δ (95% Mg), Mg, H = 10, 15, 8, 28, 4, 0, 5 kg./sq. mm.; flow pressure, 7, 3, 10, 21, 10, 11, 7 kg./sq. mm. N. Thon

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

9

Structure of some aluminum-magnesium alloys. E. M. Savitskii and M. A. Tylkina. *Doklady Akad. Nauk S.S.S.R.* 67, 81-3(1949); cf. *C.A.* 43, 2147*h*.—Contrary to expectation, the hardness of Mg-Al alloys in the range 35.5-50% Mg, where the state diagram shows β or γ phases or their mixt., is additive only at low temps., but not from 300° upwards. At 300, 400, and 430°, the alloys are much more plastic than either the β or the γ phase; thus, at 430°, the hardness of the 38.9% Mg alloy is 1/4 that of the γ and 1/4 that of the β phase. X-ray diagrams of hot-extruded wire samples showed no structural changes on heating to 400° in the case of alloys consisting only of either the β or the γ phase. However, samples which, in the annealed state, at 20°, proved to be a mixt. of the β and the γ phase, e.g. 38.9% Mg, showed, at 400°, only lines of a single phase, different from both β and γ, closer to the latter but with a simpler lattice. Alloys with 38.9-41.3% Mg, heated to 400° and quenched in ice water, showed, in micrography, one-phase structure, in contrast to the two-phase structure of the annealed alloys. The x-ray diagram of quenched sample, taken at 20°, was identical to that taken at 400°. Consequently, the anomaly of the high-temp. hardness curve as a function of the compn., in the 38.9-41.3% Mg range, is due to the single-phase structure of these alloys at higher temps. N. T.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

KRIPYAKEVICH, P.I.; TYLKINA, M.A.; TSYGANOVA, I.A.

Hafnium alloys with iron and cobalt. Zhur. neorg. khim. 9 no.11: 2599-2601 N '64 (MIRA 18:1)

1. L'vovskiy gosudarstvennyy universitet imeni I. Franko, i Institut metallurgii imeni A.A. Baykova.

ACCESSION NR: AP4041584 S/0078/64/009/007/1650/1652

AUTHOR: Ty*lkina, M. A.; Tsy*ganova, I. A.; Savitskiy, Ye. M.

TITLE: The hafnium-niobium system

SOURCE: Zhurnal neorganicheskoy khimii, v. 9, no. 7, 1964, 1650-1652

TOPIC TAGS: hafnium niobium system, hafnium niobium alloy, alloy phase composition, alloy structure, alloy property

ABSTRACT: Fourteen hafnium alloys with niobium contents of 0—100% have been studied by the method of physicochemical analysis. Alloys were melted from 98.5% pure hafnium and 99.4% pure niobium. Melting was performed in an unconsumable electrode-arc furnace in an atmosphere of helium under a pressure of 200 mm Hg. Alloys were studied in the ascast and annealed (at 750, 1000, 1500, or 1700C) conditions. Annealing at 1700 or 1500C (for 30 min) was performed in a vacuum, and annealing at 750 and 1000C (for 500 hr) in evacuated ampuls. At temperatures over 1800C, hafnium and niobium form a continuous series of solid solutions (see Fig. 1 of the Enclosure). The solubility

ACCESSION NR: AP4041584

of hafnium in niobium at 820C does not exceed 10%; that of niobium in hafnium is even lower and does not exceed 3%. No chemical compounds were discovered in the system, but a rather sharp increase of hardness in hafnium-rich alloys from 451 kg/mm^2 at 90% hafnium to 538 kg/mm^2 at 95% hafnium indicates the possibility of the existence of the metastable ω-phase, usually encountered in systems containing titanium and zirconium. Orig. art. has: 2 figures, 1 table, and 2 formulas.

ASSOCIATION: none

SUBMITTED: 09May63 ATD PRESS: 3072 ENCL: 01

SUB CODE: MM NO REF SOV: 003 OTHER: 004

ACCESSION NR: AP4041583 S/0078/64/009/007/1645/1649

AUTHOR: Savitskiy, Ye. M.; Polyakova, V. P.; Ty*lkina, M. A.; Burkhanov, G. S.

TITLE: Palladium-tantalum system

SOURCE: Zhurnal neorganicheskoy khimii, v. 9, no. 7, 1964, 1645-1649

TOPIC TAGS: palladium tantalum system, palladium tantalum alloy, palladium tantalum alloy structure, palladium tantalum alloy property

ABSTRACT: Palladium-tantalum alloys with a tantalum content varying from 0—100% were vacuum melted in a nonconsumable tungsten electrode induction furnace, in an atmosphere of purified helium, and under a pressure of 250 mm Hg, from 99.9% pure Ta and powdered 99.98% pure Pd. They were then studied by microscopic and x-ray diffraction methods, by hardness measurements, phase microhardness, and thermal emf. Alloys were studied in the as-cast condition and also after vacuum annealing at a temperature varying from 1000 to 1800C, for periods of time from 30 min to 300—500 hr; in addition, alloys containing 80% and more of Ta were annealed at 2000C for 30 min. The phase diagram

ACCESSION NR: AP4041583

of the Pd-Ta system (see Fig. 1 of the Enclosure) plotted on the basis of the obtained data is characterized by the presence of four metallic compounds in addition to limited solid solutions. One metallic compound is of a δ-phase type with a primitive tetragonal β-U lattice with the parameters a = 9.64 kX, c = 5.02 kX; it has a microhardness of ~600 kg/mm^2 and exists between 1575—2350C. The second compound with a composition close to that of the PdTa compound has a bcc tetragonal lattice with constants a = 3.28 kX, c = 6.00 kX, and a microhardness of ~600 kg/mm^2. The alloy with 35% Ta contains a Pd_3Ta compound with a $TiAl_3$-type tetragonal lattice with constants a = 3.87 kX, c = 7.94 kX, and a microhardness of ~300 kg/mm^2. Annealing at 1650C of alloys containing 40—50% Ta, in which both the Pd_3Ta and PdTa compounds are present, produced a new phase which had a microhardness of ~400 kg/mm^2 and a composition close to that of the Pd_2Ta compound; its crystal lattice has not been determined. About 27 wt% of Ta is dissolved in Pd at melting temperature and about 7% at 1000C. The hardness of cast alloys increases from 54 to 640 kg/mm^2 when the tantalum content increases from 5 to 79.73 wt% (δ-phase), and drops sharply to ~170 kg/mm^2 in an alloy containing 85 wt% Ta (β-solid solution). Orig. art. has: 7 figures and one table.

Card 2/4

ACCESSION NR: AP4041583

ASSOCIATION: none

SUBMITTED: 14Nov63 ATD PRESS: 3064 ENCL: 01

SUB CODE: MM NO REF SOV: 002 OTHER: 003

Card 3/4

ACCESSION NR: AP4041583

ENCLOSURE: 01

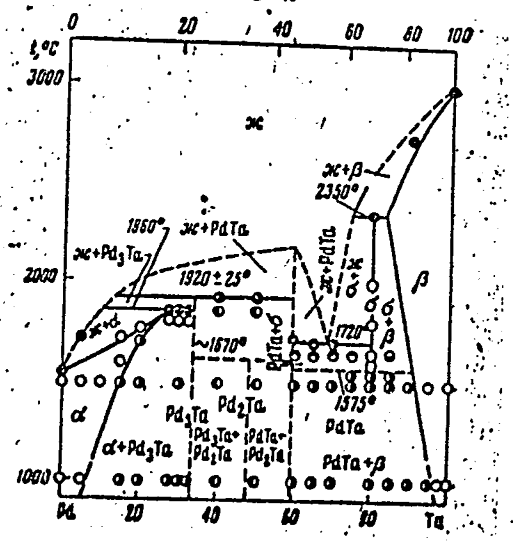

Fig. 1. Phase diagram of Pd-Ta system

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BR

ACCESSION NR: AP4019491 S/0078/64/009/003/0671/0673

AUTHORS: Ty*lkina, M. A.; Polyskova, V. P.; Savitskiy, Ye. M.

TITLE: The palladium-tungsten-rhenium system

SOURCE: Zhurnal neorg. khimii, v. 9, no. 3, 1964, 671-673

TOPIC TAGS: palladium tungsten rhenium system, property, palladium tungsten rhenium alloy, phase diagram, fusion temperature, hardness, deformability, specific resistance, temperature coefficient

ABSTRACT: A portion of the phase diagram of the Pd-W-Re system was constructed and the properties of the alloys were investigated. The phase diagram of the Pd corner of the ternary system was constructed from physical-chemical data (fig. 1). Examination of the properties of the alloys (fig. 2) shows that increasing the rhenium content in the alloys lowers the fusion temperature of the ternary melt from the direction of Pd-W to the direction of Pd-Re. An increase in the rhenium content in the alloys greatly increases their hardness and simultaneously impairs their deformability at

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ACCESSION NR: AP4019491

room temperature. Alloying Pd-W alloys with rhenium lowers the specific resistance and raises its temperature coefficient. Orig. art. has: 3 figures.

ASSOCIATION: None

SUBMITTED: 18Feb63

DATE ACQ: 31Mar64

ENCL: 02

SUB CODE: CH, ML

NR REF SOV: 003

OTHER: 000

Card 2/4

ACCESSION NR: AP4019491

ENCLOSURE: 01

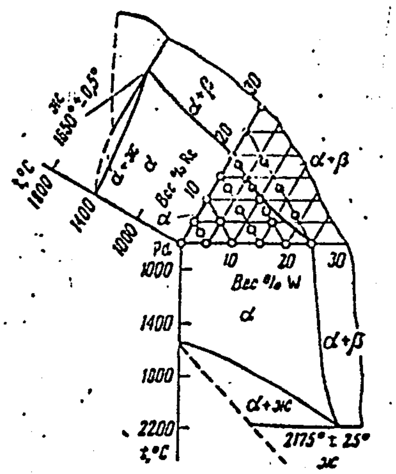

Fig.. 1

Phase diagram of the palladium corner of the ternary system palladium-tungsten-rhenium

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ACCESSION NR: AP4019491

ENCLOSURE: 02

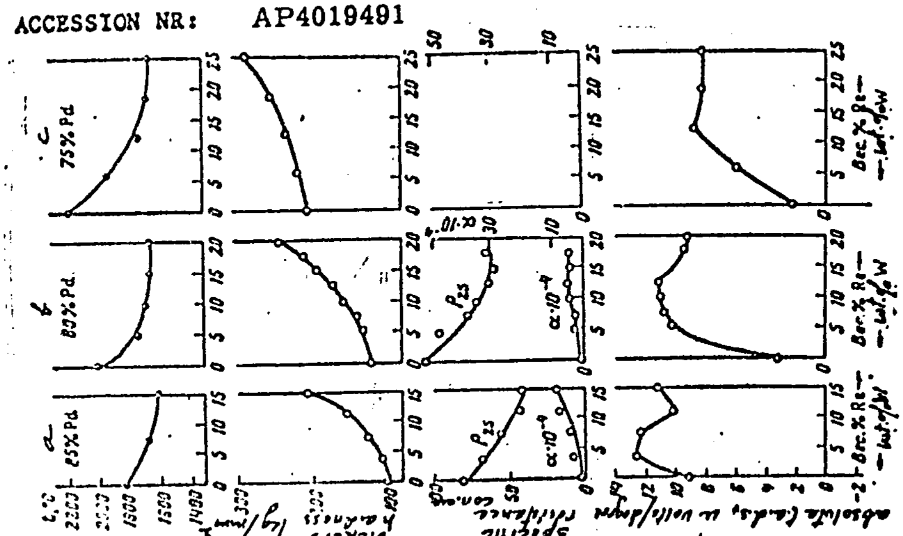

Fig. 2

Properties of palladium-tungsten-rhenium alloys: a--with constant palladium content of 85 wt. %; b--withconstant palladium content of 80 wt. %; c--with constant palladium content of 75 wt. %

Card 4/4

TYLKINA, M.A.

USSR/Engineering -- Metallography

FD-2618

Card 1/1 : Pub. 41-4/21

Author : Savitskiy, Ye. M. and Tylkina, M. A., Moscow

Title : The effect of temperature on the plasticity and resistance to deformation of commercial titanium

Periodical : Izv. AN SSSR, Otd. Tekh. Nauk 4, 53-57, Apr 55

Abstract : Presents the results of an experimental determination of plasticity and resistance to deformation at various temperatures and under various stresses of commercial carbon-free titanium and of titanium with an 0.5-0.8% carbon content. The presence of carbon within this range was found to increase the strength and decrease the plasticity at temperatures of 20-600°. It was found that carbon does not decrease the plasticity of titanium at temperatures of 700-800° and over and permits the hot deformation of titanium under low stresses. Graphs. Four USSR references.

Institution :

Submitted : February 11, 1955

USSR/Physics - Metallurgy

Card 1/1 Pub. 22 - 19/51

Authors : Savitskiy, Ye. M.; Tylkina, M. A.; and Turanskaya, A. N.

Title : Diagram of the recrystallization of iodide titanium

Periodical : Dok. AN SSSR 101/5, 857-859, Apr. 11, 1955

Abstract : A study of the dependence of the magnitude of iodide titanium grains

TYLKINA, M. A.

Savitsky, Ye. M., Tylkina, M. A., "Rhenium and its Alloys."

in book Research on Heat Resistant Alloys, pub by Acad. Sci. USSR, Moscow, 1956, 160 pp.

Inst. Metallurgy im A. A. Baykov

Translation from: Referativnyy zhurnal. Metallurgiya, 1957, Nr 1, p 198 (USSR) SOV/137-57-1-1489

AUTHORS: Savitskiy, Ye. M., Tylkina, M. A.

TITLE: Rhenium and Its Alloys (Reniy i yego splavy)

PERIODICAL: V kn.: Issledovaniya po zharoprochnym splavam. Moscow, AN SSSR, 1956, pp 33-47

ABSTRACT: The authors investigated the structure and properties of alloys of Re with Mo at different temperatures. The specimens were prepared by the cermet method. Specimens of cast Re were obtained by melting briquettes prepared from powder in an electric-arc furnace in an Ar atmosphere, at 200-mm Hg pressure. Introduction of 1, 3, 5, 10, 25, and 50 weight-% Re does not cause any changes in the microstructure; the Re dissolves in the Mo, and all these alloys have a single-phase structure of a substitution-type solid solution. The alloy with 75% Re is an intermetallic compound, expressed by the stoichiometric ratio Mo_2Re_3. With an increase in Re content up to 25-50% the hardness of the alloy increases; the alloy with 75% by weight of Re has the maximum hardness equal to 1120 kg/mm^2. A lowering of the temperature to -194°C brings about an increase in hardness; raising the

Card 1/2

temperature causes a decrease in hardness. A 90% Re alloy with a 550-kg/mm^2 hardness at room temperature maintains a 390-340 kg/mm^2 hardness in the 400-800° temperature range and 220 kg/mm^2 at 1150°. All specimens except the 75% Re alloy proved fairly ductile. Their compressive σ_b > 200 kg/mm^2. At 1000° all alloys exhibited fair ductility, except for the 75% Re alloy which disintegrated into powder. The 90% Re alloy possesses good ductility both at low and at elevated temperatures. In order to establish whether this alloy can be employed as a heat-resistant material, it should be tested for its stress-rupture properties. A vast amount of material on the physical and mechanical properties of Re is set forth in this work; phase diagrams of alloys of Re with W, Fe, Co, Cr, Mo, and Ni, microstructures of cast Re-Mo alloys, and curves of their hardness and ductility at different temperatures are given. The authors also touched on the problems of the use of Re in the national economy.

Ye. K.

TYLKINA, M.A.

USSR/Physical Chemistry, Thermodynamics, Thermochemistry, Equilibriums, Phys-Chem, Anal. Phase-transitions. B-8

Abs Jour : Ref Zhur - Khimiya, No 7, 1957, 22318.

Author : E. M. Savitzky, M. A. Tylkina, A. N. Turnaskaya.
Inst : Not given
Title : Study of titanium and its alloys recrystallization. (Diagrams of titanium recrystallization).

Orig Pub : Izv. A.N. USSR, Otd. Tekhn. n. 1956, No 7, 111-114.

Abstract : Diagrams of recrystallization of titanium iodide and titanium thermal magnesium (brand BTI-D) are plotted, which link together the size of metal grain with the deformation degree and with the subsequent annealing temperature or with the hot deformation temperature are plotted; recrystallization of hot rolled Ti calcium hydride is also studied. In connection with titanium's polymorphism and different capacity of α and β, modifications to produce the grain growth, it is necessary to consider each diagram of recrystallization as consisting of 2 diagrams, corresponding to temperature areas of existence of α and β -ti. α Ti is characterized by a fine grained polyhedral structure, insensibility to the cooling rate after heating, and

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USSR/Physical Chemistry, Thermodynamics, Thermochemistry, Equilibriums, Phys-Chem, Anal. Phase-transitions. B-8

Abs Jour : Ref Zhur - Khimiya, No 7, 1957, 22318.

the presence of critical size grains as a result of an annealing after a cold deformation of 2.5-7% β-Ti is characterized by a coarse grain and a great sensibility to the cooling rate (the appearance of phase grains of different shapes and sizes). The outlines of grain limits of iodide and magnesium thermal Ti are maintained at any cooling rate but in case of calcium hydride- only at a fast cooling. The optimal annealing temperature is equal to 650-850° dependent on the purity of Ti and the degree of deformation. In conditions of forging under a pile driver or rolling with a 0.5 m/sec speed, recrystallization in technical Ti does not occur.

Card 2/2

FYLKINA M.

Tylkina, M. A.

137-1957-12-25299

Translation from: Referativnyy zhurnal, Metallurgiya, 1957, Nr 12, p 334 (USSR)

AUTHORS: Savitskiy, Ye. M., Tylkina, M. A.

TITLE: Mechanical Properties of Cast Rhenium (Mekhanicheskiye svoystva litogo reniya)

PERIODICAL: Tr. In-ta metallurgii. AN SSSR, 1957, Nr 1, pp 158-161

ABSTRACT: Castings of Re to be investigated were obtained by melting sintered powdered metal in an argon-arc furnace. Hardness tests, conducted in the temperature range between -194° and +1150°, showed that H_k varies from 400 kg/mm^2 to 134 kg/mm^2, respectively. Plasticity was determined at 20° and 1000°. At 20° and a compressive σ_b of 200 kg/mm^2, the compression was 25-30 percent. At 1000° the compression was 60 percent. Cold working increases the hardness by approximately 80 percent. Recrystallization begins at approximately 1500°. Bibliography: 7 references.

P. N.

Card 1/1 1. Rhenium castings-Mechanical properties-Test results

TYLKINA, M.A.

18(2) PHASE II - ABSTRACTS AB-1

Akademiya nauk SSSR. Institut metallurgii

Titan i yego splavy; metallurgiya i metallovedeniye (Titanium and Its Alloys; Metallurgy and Physical Metallurgy) Moscow, Izd-vo AN SSSR, 1958. 209 p. 4,000 copies printed.

Resp. Ed.: N.V. Ageyev, Corresponding Member, USSR Academy of Sciences; Ed. of Publishing House: V.S. Rzheznikov; Tech. Ed.: A.A. Kiseleva.

INTRODUCTION: This book, of which a Phase I Exploitation (SOV/1200) has been prepared, is a collection of scientific papers devoted to the study of titanium and its alloys from three main points of view: physical metallurgy, forming, and welding. Special problems investigated include structural changes occurring during welding, determination of the content of harmful gases, development of industrial methods of rolling, and oxidation at various temperatures.

PART I. PHYSICAL METALLURGY

Card 1/43

Tylkin, M.A.

130-1-3/17

AUTHORS: Tylkin, M. A., Engineer and Kershteyn, M. I., Engineer.

TITLE: Hard-facing Parts (Naplavka detaley tverdymi splavami)

PERIODICAL: Metallurg, 1958, No.1, pp. 5-6 (USSR)

ABSTRACT: At the imeni Dzerzhinskiy (imeni Dzerzhinskogo) Works, hard-facing with stalinite, sormite (sormayt) and type T-590 and T-620 electrodes is adopted. The author gives some examples, including lugs on sinter-breaker sprockets (Fig.1), pug-mill blades (Fig.3) and guide baffles on crane columns. In the last application, the adoption of the hard-facing technique has enabled steel to be used instead of bronze for the baffles. The author gives details of clamping methods and pre- and post-facing treatments, as well as of the main facing operation. There are 5 figures.

ASSOCIATION: imeni Dzerzhinskiy Works (Zavod imeni Dzerzhinskogo)

AVAILABLE: Library of Congress

Card 1/1

TYLKINA, M.A.

24-58-3-11/38

AUTHORS: Savitskiy, Ye.M., Tylkina, M.A., Tsyganova, I.A. (Moscow)

TITLE: Influence of Alloying Additions on the Recrystallization Temperature and on the Mechanical Properties of Titanium. (Vliyaniye legiruyushchikh dobavok na temperaturu rekristallizatsii i mekhanicheskiye svoystva titana)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, 1958, Nr 3, pp 96-103 and 1 plate (USSR)

ABSTRACT: This paper is a continuation of earlier work of the authors and their team on the recrystallization and the mechanical properties of Ti of various degrees of purity and of Ti alloys (Refs.1-6). Reinbach and Nowikow (Ref.7) published preliminary data on the influence of certain additions (up to 1%) on the change in the time required to attain complete recrystallization of commercial Ti at a given annealing temperature; they found that introduction of chromium slows down the process of recrystallization whilst other admixtures (Co, Al, Fe, Ta and Sn) showed almost no influence on the duration of attaining complete recrystallization. In this paper an attempt is made to classify the alloying elements from the point of view of their influence on the recrystallization temperature and the mechanical properties whereby these characteristics are considered as a function of the character

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24-58-3-11/38

Influence of Alloying Additions on the Recrystallization Temperature and on the Mechanical Properties of Titanium.

of the interaction of Ti with the alloying additions, their crystal structure and also the temperature of polymorphous transformation. The relations published by Bochvar (Ref.8) and by Kurilekh (Ref.9), interrelating the recrystallization temperature of metals with their fusion temperature, are not applicable to alloys. The complexity of diffusion processes in solid solutions, the differing character of these solutions and the presence of second phases in the alloys are all factors which complicate the process of recrystallization. One important factor which has not been taken into consideration so far is the presence in metals or alloys of the phenomenon of polymorphism. In the view of the authors of this paper, in metals and alloys in which polymorphous transformation takes place, the recrystallization temperature should be closely linked with the temperature of the polymorphous transformation in addition to the influence of other factors. It is obvious that in alloys in which such transformation takes place all the recrystallization processes are fully completed in the range of existence of lower temperature

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24-58-3-11/38

Influence of Alloying Additions on the Recrystallization Temperature and on the Mechanical Properties of Titanium.

modifications (particularly α modification in Ti) and when the temperature of polymorphous transformation is reached, phase recrystallization and reconstruction of the crystal lattice is already proceeding. The experiments were carried out with an iodide Ti of 99.96% purity alloyed with additions of the following 14 elements: V, Nb, Fe, Co, Mn, Cr, N, C, O, Al, Be, Re, Sn and Boron. For each of the alloying additions, 4 to 5 alloys were prepared and the content of each of the additions in the alloy was chosen in such a way that alloys were obtained which are located in various phase ranges of the system, namely, alloys possessing uniform α and β structures, 2-phase α + β or α + chemical compound structures. The compositions of the alloys are entered in the table on p.97. Graphs are included showing the influence of the annealing temperature on the hardness, the influence of the alloying additions on the recrystallization temperature, on the ultimate strength, elongation and contraction. It was found that almost all of the investigated alloying additions bring about an increase in the recrystallization temperature. As regards the degree of their influence these elements can be subdivided into the following three groups: elements which

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Influence of Alloying Additions on the Recrystallization Temperature and on the Mechanical Properties of Titanium.

bring about a considerable increase in the recrystallization temperature at low contents of the respective element (N, O, C, Boron, Be, Re and Al); elements which bring about an increase in the recrystallisation only if the content is of the order of 3% and higher (Fe, Cr, V, Mn, Sn); elements which have practically no influence on the initial recrystallization temperature (Nb and Co). The following relation was derived between the recrystallization temperature, T_1 and the temperature of the polymorphous transformation, T_2, of the alloy: $T_1/T_2 = 0.7 \div 0.9$. For Ti this ratio equals 0.71, for low alloy alloys this ratio equals 0.7 - 0.75 and increases to 0.8 - 0.9 with increasing contents of the alloying element. The alloying additions bring about an increase in the tensile strength and hardness, maximum values being $\sigma_B = 92$ kg/mm^2 and $R_B = 105$ and a reduction in the ductility. The greatest influence is exerted by elements which bring about a maximum increase in the recrystallization temperature and

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Influence of Alloying Additions on the Recrystallization Temperature and on the Mechanical Properties of Titanium.

belong to the first of the above-mentioned group, i.e., N, O, C, Be, B. The other investigated elements have less influence on increasing the strength and for a content of 5% these elements can be classified from the point of view of increasing the strength in the following sequence: Cr, Co, Nb, V, Mn, Fe and Sn. The greatest drop in plasticity is observed when introducing Fe, Co and Nb. There are 9 figures, 1 table and 15 references, of which 10 are Soviet, 4 German and 1 English.

SUBMITTED: April 5, 1957.

Card 5/5 1. Titanium--Mechanical properties 2. Titanium alloys--Recrystallization 3. Temperature--Effects

78-3 3-38/47

AUTHORS: Savitskiy, Ye. M., Baron, V. V., ~~Tylkina, M. A.~~

TITLE: The Phase Diagrams and Properties of Gallium and Thallium Alloys (Diagrammy sostoyaniya i svoystva splavov galliya i talliya)

PERIODICAL: Zhurnal Neorganicheskoy Khimii, 1958, Vol. 3, Nr 3, pp. 763-775 (USSR)

ABSTRACT: The structural and physico-mechanical properties of the alloys of gallium with silicon and germanium in all concentrations as well as of gallium with antimony, manganese, copper and thallium with lanthanum were investigated. The phase diagram of gallium with silicon is of an eutectic type. All alloys consist of two phases. The addition of silicon to gallium highly increases the hardness and the electric resistance of silicon. The phase diagram of gallium and germanium also is of an eutectic type. The eutectic composition melts at 29°C and has a gallium content of 99,45 %. All alloys of this system possess metallic conductivity.
The structure and the properties of the alloys of gallium and

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78-3 3-38/47

The Phase Diagrams and Properties of Gallium and Thallium Alloys

antimony were examined for hardness, microhardness, plasticity, strength and electric resistance between 20 and 600°C. Alloys with 63,59 - 64,08 % antimony at room temperature have a maximum electric resistance which decreases with a rise of temperature. This proves that these alloys possess properties of semiconductors. The structure and the properties of the alloys of gallium with 50 - 86,3 % gallium were examined by microstructure, hardness, strength, microhardness and electric resistance at temperatures of 20-300°C. The following compounds occur in the alloys: MgGa and Mg_5Ga_2. Alloys in the domain of the compound MgGa show the highest hardness and the smallest strength and plasticity. The system gallium-copper with 15 - 85 % gallium was also investigated for microstructure, hardness, strength, microhardness and electric resistance. The results showed that by the addition of gallium to copper hardness, strength and electric resistance increase, but that the plasticity decreases. The electric resistance of the alloys increases with a rise of temperature. The phase diagrams and the properties of the alloys of gallium with germanium, gallium with silicon and gallium with lanthanum were also investigated. Alloys between silicon and thallium do not occur. In the system lanthanum-

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The Phase Diagrams and Properties of Gallium and Thallium Alloys 78-3 3-38/47

-thallium the compound La_2Tl occurs which possesses an high electric resistance and an high hardness. There are 15 figures and 19 references, 0 of which are Soviet.

ASSOCIATION: Institut metallurgii im. A. A. Baykova, Akademii nauk SSSR (Metallurgical Institute imeni A. A. Baykov, AS USSR)

SUBMITTED: June 25, 1957

Card 3/3

78-3-3-46/47

AUTHORS: Savitskiy, Ye. M., Tylkina, M. A.

TITLE: Alloys of Rhenium With High-Melting Metals (Mo, Ti, Zr, Ta, Ni, Co, Cr, W, Mn) (Splavy reniya s tugoplavkimi metallami (Mo, Ti, Zr, Ta, Ni, Co, Cr, W, Mn))

PERIODICAL: Zhurnal Neorganicheskoy Khimii, 1958, Vol. 3, Nr 3, pp. 820-836 (USSR)

ABSTRACT: The investigations were performed with different physico-chemical methods, especially by the determination of the melting point. On the basis of these investigations the nature of the alloys in the case of the influence of rhenium upon high-melting metals was determined. The modification of the hardness, the melting point and the electric resistance in this system was observed. In the system Ti-Re a larger solubility domain of rhenium in β-titanium was determined. On the introduction of 15 % rhenium the β-phase of titanium is stabilized. In general the addition of rhenium to titanium increases the thermal stability. In the system Mo-Re solid solutions occur. At a temperature of 2570°C an σ-phase occurs by peritectic reaction. The boundary of the

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Alloys of Rhenium With High-Melting Metals (Mo, Ti, Zr, Ta, Ni, Co, Cr, W, Mn) 78-3-3-46/47

solid solutions of rhenium in molybdenum was not exactly determined. In the system Ta-Re in the case of 60 - 70 % rhenium the compound Re_3Ta_2 was determined. On addition of 60 - 80 % rhenium the alloys in this system are brittle and breakable. In the system Co-Re an uninterrupted series of solid solutions with an hexagonal crystal lattice between α-cobalt and rhenium was determined. In the system Ni-Re solid solutions of rhenium in nickel (α-phase) occur and solid solutions of nickel in rhenium (β-phase). The boundary between these two phase domains lies at 1200°C in the case of 40 - 75 % rhenium. In the system Cr-Re domains of solid solutions of rhenium in chromium occur. In the case of 70 - 85 % rhenium a chemical compound forms which possesses a hardness of 1000 kg/mm^2. A smaller addition of rhenium to chromium increases the plasticity of chromium. In the system Zr-Re two chemical compounds form: 1) In the case of 50 % rhenium - $ReZr_2$, with a melting point at 1900°C and an hardness of 800 - 1000 kg/mm^2; 2) In the case of 70 - 80 % rhenium - Re_2Zr, with a melting point at 2400°C and an hardness of 1200 kg/mm^2. Solid solutions of rhenium in β-zirconium occur at up to 15 % rhenium. In the system Mn-Re with up to 5 % rhenium solid solutions occur. On addition of 24,6 %

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78-3-3-46/47

Alloys of Rhenium With High-Melting Metals (Mo, Ti, Zr, Ta, Ni, Co, Cr, W, Mn)

rhenium a polymorphous transformation of β to α occurs, at 760°C. In the system W-Re with 60 % rhenium a phase of W_2Re_3 forms, with a melting point at 3007°C. In this system an σ-phase also occurs at 35 - 58 At% as well as solid solutions of tungsten in rhenium at 75 % rhenium. In all investigated systems the produced alloys have a lower melting point than rhenium. There are 17 figures, 6 tables, and 35 references, 12 of which are Soviet.

ASSOCIATION: Institut metallurgii im. A. A. Baykova, Akademii nauk SSSR, Moskva
(Moscow Metallurgical Institute imeni A. A. Baykov, AS USSR)

Card 3/3

/2001 CIA-RDP86-00513R001757720002-0

20-118-4-26/61

AUTHORS: Savitskiy, Ye. M., Tylkina, M. A., Tsyganova, I.

TITLE: The Recrystallization Diagram of Tantalum (Diagramma rekristallizatsii tantala)

PERIODICAL: Doklady Akademii Nauk SSSR, 1958, Vol. 118, Nr 4, pp. 720-722 (USSR)

ABSTRACT: There are no data in publications on the recrystallization of cast tantalum. In recent time, however, the smelting of tantalum in the arc is more and more used. The high corrosion resistance of tantalum in an aggressive medium, the low fusibility and high plasticity which permits a cold working, as well as many other properties permit to count tantalum among the technically most important metals. The diagram in question com bines the grain size with the degree of deformation and the temperature of the subsequent annealing. It is therefore especially necessary for the metals worked by means of deformation. The results obtained will make possible to choose th deformation- and annealing conditions in such a way that th optimum mechanical properties of the products are guarante The authors constructed a diagram of the type I for the co working (rolling) of the cast tantalum (figure 1). The

conditions of cooling on a copper furnace bottom favored the formation of a coarse-grained structure in tantalum (figure 2a). Cast bars were cold-worked by forging until rods 7 x 7 were produced. They were annealed in vacuum at 1300° C for two hours. Thus the coarse-crystalline structure was completely transformed in a recrystallized, fine-grained, polyhedral structure (grain diameter 10-11μ, figure 2 b). Such rods served as initial material for the experiments. The rods were cold-rolled without intermediate annealing, with a shrinkage of 2,6; 5,7; 8; 10; 15; 34; 50; 68; 83; 90; 96; 98; 6%. The rolled rods were cut into pieces of 8-10 mm length and annealed in vacuum at 1000-2500° for one hour. The line of the beginning of the recrystallization in dependence on the deformation degree is plotted in a dotted line in figure 1. The temperature of the beginning of the recrystallization of tantalum drops with the rising deformation degree from 2,6 to 84% from 1300 to 1200° C. Figure 3 gives some radiographs of tantalum. The cold-rolling up to 15% deformation distorts the lattice of tantalum and deforms the individual grains. The microstructure is, however, not considerably modified. In the case of shrinkage of more than 30% a distinctly marked rolling-texture becomes visible (figure 2 v). The grains are

The Recrystallization Diagram of Tantalum

20-118-4-26/61

changed to a great extent and extended up to $\sim$50 - 60% shrinkage without size reduction. In the case of a deformation of 90% the grain diameter amounts to 1 - 2 μ. Annealing at 1000 - 1600° C does not lead to a considerable enlargement of the grains. A recrystallization at 1200° C leads in samples with a high deformation degree and a recrystallization at 1600° in all samples to a complete blur of the rolling texture and to the appearance of new fine crystallized grains of a diameter of 6 - 13 μ. The annealing at 1800 - 2000° C leads to an abrupt change of size of the grains in connection with a collecting recrystallization (figure 2 g,d). The grain size increases at 1800° C threefold up to 31 μ and at 2000° C tenfold (up to 115 μ). The maximum sizes of the grains which correspond to the critical deformation degrees become visible in the isothermal lines of annealing at 1800 and 2000°. In the annealing at 2500° C an apparently specific property of tantalum becomes visible: the size of the grains increases to an extremely great extent (320 - 500 μ). The properties of hardness and strength of tantalum in individual deformation degrees and annealing temperatures admit the assumption that the optimum annealing treatment lies at 1300 - 1400° C. There are 3 figures and 5 references, 1 of which is Soviet.

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The Recrystallization Diagram of Tantalum 20-118-4-26/61

PRESENTED: August 3, 1957, by I. P. Bardin, Academician

SUBMITTED: July 25, 1957

AVAILABLE: Library of Congress

Card 4/4

AUTHORS: Savitskiy, Ye. M., Tylkina, M. A., Povarova, K. B. 20-119-2-23/60

TITLE: Rhenium Recrystallization Diagram (Diagramma rekristallizatsii reniya)

PERIODICAL: Doklady Akademii Nauk SSSR, 1958, Vol 119, Nr 2, pp 274 - 277 (USSR)

ABSTRACT: Rhenium has different mechanical and physical properties which distinguish it from other metals and which are also of interest for modern engineering. Rhenium is a high melting metal, its melting point is at 3160°C. It has mechanical high strength and plasticity properities at room temperature as well as at higher temperature. The following is characteristic for rhenium: high resistance to wear, and resistance against corrosion in various aggressive media. The electric resistance of rhenium is higher than that of tungsten. Also other properties offer wide prospects for the use of rhenium in different fields of engineering. The recrystallization diagram of rhenium has hitherto not yet been published. The authors investigated the recrystallization diagrams of rhenium after cold deformation

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Rhenium Recrystallization Diagram

20-119-2-23/60

(rolling) of cast and metal-powder samples. As initial material served the powder of metallic rhenium which had been reduced from potassium perenate (perenat kaliya). From this powder the samples were produced by powder metallurgical methods. These rhenium bars were melted in an arc furnace in an argon atmosphere at a pressure of 200 torr. The coarse crystalline structure of the cast metal could be removed. The samples had a recrystallized polyhedral structure with a grain diameter of 40μ and served as initial material for the whole work. The treatment of the samples is shortly discussed. The temperature at the beginning of recrystallization was determined by means of X-ray methods from the occurence of the first points on the diffraction rings. A diagram shows the temperature of the beginning of recrystallization of rhenium as a function of the degree of cold deformation. This temperature drops with increasing deformation degree 1750°C at 5% deformation to 1200°C at 40 -60% deformation. In cold deformation of rhenium the grains were crushed. In the case of low compression degrees the formation of deformation twins is observed in rhenium. Further details are discussed. The temperature of the beginning of re-

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Rhenium Recrystallization Diagram

20-119-2-23/60

crystallization of powder metallurgical rhenium drops with increasing deformation degree from 1850°C at 5 % to 1500°C at 48% of deformation. A diagram shows the dependence of the size of the grains on the temperature of annealing as well as on the degree of deformation. The temperature of the beginning of crystallization of molten rhenium is lower than that of the beginning of recrystallization of powder-metallurgical rhenium which is explained by the different degree of purity of the material as well as by the presence of a microporosity in powdermetallurgical rhenium. According to the data on the recrystallization and on the change of the hardness of rhenium the optimum temperature for annealing of the rhenium deformed with a compression degree of more than 10% the temperature range from 1750 - 2400°C can be assumed. There are 4 figures and 7 references, 5 of which are Soviet.

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Rhenium Recrystallization Diagram

20-119-2-23/60

ASSOCIATION: Institut metallurgii im. A. A. Baykova Akademii nauk SSSR (Institute for Metallurgy imeni A. A. Baykov, AS USSR)

PRESENTED: November 20, 1957, by I. P. Bardin, Member, Academy of Sciences, USSR

SUBMITTED: November 16, 1957

Card 4/4

TYLKINA, M. A.

Akademiya nauk SSSR. Institut nauchno-tekhnicheskoy informatsii

Metallurgiya i metallovedeniye; khimiya, metallovedeniye i obrabotka titana (Metallurgy and Metallography; Chemistry, Metallography, and Treatment of Titanium) Moscow, Izd-vo AN SSSR, 1959. 383 p. (Series: Itogi nauki; tekhnicheskiye nauki, 2) Errata slip inserted. 2,700 copies printed.

Ed.: N. V. Ageyev, Corresponding Member, Academy of Sciences, USSR; Ed. of Publishing House: V. S. Rzheznikov; Tech. Ed.: Yu. V. Rylina.

PURPOSE: This collection of articles is intended for metallurgists working with titanium and titanium alloys.

COVERAGE: The articles in this collection deal with the chemistry, metallurgy, and machining of titanium and titanium alloys. The articles are based on abstracts appearing in the Referativnyy zhurnal for chemistry and metallurgy, from 1953 to 1955. For the most part the articles are based on non-Soviet material. No personalities are mentioned. References follow each article.

Savitskiy, Ye. M., and M. A. Tylkina. Properties of Titanium and Titanium Alloys 103

This is a survey of the physical and mechanical properties of titanium and titanium alloys. Data are given on the effect of oxygen, nitrogen, hydrogen, and carbon on the mechanical properties of titanium.

Gudtsov, N. T., and L. D. Mashtakova. Heat Treatment of Titanium and Titanium Alloys 163

The authors discuss work hardening, annealing, grain refining, and other heat-treating methods for titanium and titanium alloys. Also discussed are the effect of alloying elements on heat-treating characteristics, mechanical properties after heat treating, and structural changes at heat treating.

Arshanyy, P. M. Thermochemical Treatment [Diffusion Coating] of Titanium 187

This article deals with the nitriding, boronizing, and siliconizing of titanium.

Shelest, A. Ye., A. N. Danil'chenko, and I. M. Pavlov. Forming of Titanium and Titanium Alloys 195

The authors discuss the special features of plastic deformation, general characteristics of cold and hot working, individual forming operations, preparatory and finishing operations, organization of production, and storage and utilization of waste.

Savitskiy, Ye. M., and M. A. Tylkina. Recrystallization of Titanium Alloys 226

Recrystallization of magnesium-reduced and iodide titanium is discussed in reference to its occurrence after cold working, hot forging, annealing, tempering, and hardening. Data are also given on the effect of the annealing temperature on the properties of titanium and the effect of alloying additions on the recrystallization temperature.

Babareko, A. A. Deformation and Recrystallization Textures of Titanium and Titanium Alloys 247

The article deals with textures assumed by titanium and titanium alloys after different forming operations.

Shc...orov, M. Kh., and G. V. Nazarov. Welding and Soldering of Titanium and Titanium Alloys 252

Welding characteristics of titanium are discussed. Data are given on welding and soldering methods.

Malent'yev, B. N., and A. I. Ponomarev. Methods for [Chemical] Analysis of Titanium and Titanium Products 285

Data are furnished on qualitative, volumetric, polarographic, and colorimetric methods of analysis. Phase analysis is also discussed.

Romanov, K. P. Theory and Practice of Machining Titanium Alloys 311

The following topics are discussed: determination of machinability; causes of poor machinability; effect of coolants, lubricants, and other factors on machinability; materials ... machining titanium alloys, machining ... [illegible]

Tylkina, M.A.

18(7) PHASE I BOOK EXPLOITATION SOV/3355

Akademiya nauk SSSR. Institut metallurgii. Nauchnyy sovet po probleme zharoprochnykh splavov

Issledovaniya po zharoprochnym splavam, t. IV (Studies on Heat-resistant Alloys, vol. 4), Moscow, Izd-vo AN SSSR, 1959. 400 p. Errata slip inserted. 2,200 copies printed.

Ed. of Publishing House: V. A. Klimov; Tech. Ed.: A. P. Guseva; Editorial Board: I. P. Bardin, Academician; G. V. Kurdyumov, Academician; N. V. Ageyev; Corresponding Member, USSR Academy of Sciences; I. A. Oding, I. M. Pavlov, and I. F. Zudin, Candidate of Technical Sciences.

PURPOSE: This book is intended for metallurgists concerned with the structural metallurgy of alloys.

COVERAGE: This is a collection of specialized studies of various problems in the structural metallurgy of heat-resistant alloys. Some are concerned with theoretical principles, some with descriptions of new equipment and methods, others with properties of specific materials. Various phenomena occurring under specified conditions are studied and reported on. For details, see Table of Contents. The articles are accompanied by a number of references, both Soviet and non-Soviet.

Studies (Cont.) SOV/3355

Card 8/12

SOV/180-59-3-17/43

AUTHORS: Savitskiy, Ye.M., Tylkina, M.A. and Shishkina, L.L. (Moscow)

TITLE: The Phase Diagram of the Tungsten-Rhenium System and Properties of its Alloys

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Metallurgiya i toplivo, 1959, Nr 3, pp 99-107(USSR)

ABSTRACT: Microstructural and X-ray investigations were used as a basis for constructing the phase diagram. Melting points, hardness and microhardness of the various constituents were measured. The resulting phase diagram is given in Fig 1. Microstructures are shown in Fig 2 and 3 and X-ray photographs in Fig 4. There is a solid solution (α) up to 45% Re near the alloy melting point, falling to 32% at 1100°C. In this region hardness increases with increasing Re content to 420 kg/mm^2 at 25% Re. A peritectic reaction takes place at 2890°C. Liquid $+\alpha \rightleftarrows \sigma$. The σ phase has a complex tetragnal lattice with a = 9.53A, c = 4.95A and c/a = 0.52. This phase extends from 40 to 66 wt % Re at 1100°C and from 45 to 66% at 2000°C. It is very brittle and has a hardness of 2000 kg/mm^2. The solid solution of tungsten in rhenium extends to 15% W near the melting point and

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SOV/180-59-3-17/43

The Phase Diagram of the Tungsten-Rhenium System and Properties of its Alloys

12% at 1100°C. There is a eutectic between the σ phase and the β solid solution at 75% Re and 2815°C. The microhardness of the eutectic is 800 kg/mm². The two phase region (β + σ) is very narrow. There is a peritectoid reaction as follows: σ + β ⇄ X. The X phase has parameter a = 9.57A and is of the α-Mn type. Its microhardness is 1500 kg/mm². Alloys with up to 20% Re have high electrical resistance, strength and plasticity. Fig 1 shows the influence of temperature on properties and Fig 5 the influence of Re on strength. W-Re alloys could be used in the electrical industry. Fig 6 shows the external appearance of electrical contacts after corrosion in moisture. Re after 50 days (a) is in much better condition than W after 30 days and (b) W-Re alloys could also be used in industry where high mechanical properties and close tolerances are required. There are 6 figures, 1 table and 11 references, 3 of which are

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SOV/180-59-3-17/43

The Phase Diagram of the Tungsten-Rhenium System and Properties of its Alloys

English, 1 German, 1 Polish and 6 Soviet.

SUBMITTED: February 7, 1959

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SOV/78-4-2-27/40

18(6)

AUTHORS: Savitskiy, Ye. M., ~~Tylkina, M. A.~~, Povarova, K. B.

TITLE: The Phase Diagram of the System Rhenium-Molybdenum (Diagramma sostoyaniya sistemy reniy-molibden)

PERIODICAL: Zhurnal neorganicheskoy khimii, 1959, Vol 4, Nr 2, pp 424-434 (USSR)

ABSTRACT: The phase diagram of the system Mo-Re was drawn on the basis of the results obtained by physico-chemical and analytical investigations (determination of the melting point, microscopic, X-ray, and phase analyses, determinations of the specific electric resistance, and determination of solidity). For the production of the alloys maximum purity rhenium (99.8%) and molybdenum (99.8%) were used as initial materials. The pressed samples were sintered in vacuum at 1500°. In the system rhenium-molybdenum solid solutions containing 58 weight% rhenium (42 at % Re) are formed at temperatures near the melting point. The solidity of molybdenum alloys increases, in the field of solid solutions, from 130 kg/mm^2 (pure molybdenum) to 205 kg/mm^2 for the alloy containing 53 weight% rhenium. In alloys with 43-46 weight % rhenium the liquidus and solidus curve of the solid solutions show a minimum at a

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SOV/78-4-2-27/40

The Phase Diagram of the System Rhenium-Molybdenum

temperature from 2450±30°. The X-ray analysis showed that upon increase of rhenium content the lattice constant in the solid solution is reduced and is 3.12 Å in the alloy with 53 weight %. The determination of the electric resistance confirmed the range of solid solutions. The specific electric resistance of pure molybdenum is $6.6.10^{-6}$ ohm·cm, and rises to $27.6.10^{-6}$ ohm·cm in alloys with 42 weight % rhenium. In the system Mo-Re the σ-phase (Re_3Mo_2) is formed after a peritectic reaction at 2570°. The lattice parameters of the σ-phase are: a = 9.54 Å and c = 4.95 Å. The micro-solidity of the σ-phase is 1850 kg/mm^2. The specific electric resistance of the σ-phase is stronger than that of the solid solution and amounts to $3.1.10^{-4}$ ohm·cm in the alloy with 78 weight % Re. The di-phase field α + σ exists between the σ-phase and the field of solid solutions. The mono-phase field of solid solutions of molybdenum in rhenium exists at the melting point temperature starting with 10 weight % molybdenum and amounts up to 2-3 weight % Mo at 1100°. The solidity of the alloy with

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SOV/78-4-2-27/40

The Phase Diagram of the System Rhenium-Molybdenum

95 weight % Re is reduced to 320 kg/mm^2, and to 290 kg/mm^2 in pure rhenium. In these alloys also the electric resistance is reduced to $57 \cdot 10^{-6}$ ohm.cm for the alloy with 95 weight % Re. In the system Mo-Re the phase χ is formed after the peritectic reaction at 1850°. The peritectic change $\sigma + \beta \rightleftarrows \chi$ takes place in alloys which contain 81-95 weight % rhenium. The χ - phase has the structure of type α-Mn as has been found by X-ray analysis. The microscopic examinations of solidity and electric resistance of alloys with 81-95 weight % rhenium prove the existence of the χ -phase. The solidity and electric resistance of the alloys are increased by the formation of the new phase χ. There are 7 figures, 2 tables, and 11 references, 3 of which are Soviet.

ASSOCIATION: Institut metallurgii im. A. A. Baykova Akademii nauk SSSR (Institute of Metallurgy imeni A. A. Baykov of the Academy of Sciences, USSR)

SUBMITTED: November 25, 1957

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18(6),18(7) SOV/78-4-3-34/34

AUTHORS: Savitskiy, Ye. M., Tylkina, M. A., Zot'yev, Yu. A.

TITLE: The Phase Diagram Rhenium - Titanium (Diagramma sostoyaniya sistemy reniy-titan)

PERIODICAL: Zhurnal neorganicheskoy khimii, 1959, Vol 4, Nr 3, pp 702-704 (USSR)

ABSTRACT: The system rhenium - titanium was investigated by the method of metallographical analysis and X-ray analysis. Melting point, electric resistance and hardness of the alloys were determined. As initial materials titanium and rhenium with a purity of 99.8% were used. On the basis of investigations an orientation phase diagram of the system was plotted. In the system solid solutions of rhenium occur in β titanium which spread up to 80 wt% rhenium. At 95 wt% rhenium (82.5 atom%) the chemical compound $Re_{24}Ti_5$ is formed. This compound is brittle and the hardness amounts to 1800-2000 kg/mm^2. The solubility of titanium in rhenium amounts to several %. By means of microscopic and X-ray analysis and the dilatometric investigation of the alloys rich in titanium the limit of the phase ranges α, $\alpha+\beta$ and β

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The Phase Diagram Rhenium - Titanium SOV/78-4-3-34/34

was fixed. The solubility of rhenium in α titanium amounts at 725° to 0.1% and rises inconsiderably with rising temperature . In alloys with 10-15% rhenium the ω phase occurs, which was also confirmed by X-ray analysis. The determinations of the electric resistance of the alloys hardened at various temperatures show that with an increase of the rhenium content also the electric resistance increases. The electric resistance in alloys hardened at 700° with 23.7% Re amounts to 131 μ ohm·cm and in the case of alloys with purest titanium to 44.5 μ ohm·cm. Alloys with 46% rhenium show no noticeable increase in the electric resistance. The alloys hardened at 900° have a higher electric resistance than those hardened at 700°. There are 2 figures and 3 references, 2 of which are Soviet.

ASSOCIATION: Institut metallurgii im. A. A. Baykova Akademii nauk SSSR (Institute of Metallurgy imeni A. A. Baykov of the Academy of Sciences, USSR)

SUBMITTED: April 2, 1958

USCOMM-DC-60,727

Card 2/2

SAVITSKIY, Ye.M., doktor khim. nauk, otv. red.; RYABCHIKOV, D.I., doktor khim. nauk, red.; BIBIKOVA, V.I., doktor tekhn. nauk, red.; TYLKINA, M.A., kand. tekhn. nauk, red.; POVAROVA, K.B., kand. tekhn. nauk, red.; BORISOVA, L.V., inzh., red.; MAKARENKO, M.G., red.

[Rhenium; transactions] Renii; trudy. Moskva, Nauka, 1964. 257 p. (MIRA 18:1)

1. Vsesoyuznoye soveshchaniye po probleme reniya. 2d, 1962.

L 23883-65

(hardness of alloys of the system rhenium ... platinum-group metals

strength and plasticity of palladium-rhenium alloys). The article concludes with a description of the electrical properties of such alloys (resistance, thermoelectr...

SUB CODE: MM

NO REF SOV: 009 OTHER: 002

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APPROVED FOR RELEASE: 08/31/2001 CIA-RDP86-00513R001757720002-0"

SAVITSKIY, Ye.M.; POLYAKOVA, V.P.; TYLKINA, M.A.; BURKHANOV, G.S.

System palladium - tantalum. Zhur. neorg. khim. 9 no.7: 1645-1649 Jl '64. (MIRA 17:9)

TYLKINA, M.A.; TSYGANOVA, I.A.; SAVITSKIY, Ye.M.

System hafnium - niobium. Zhur. neorg. khim. 9 no.7:
1650-1657 Jl '64. (MIRA 17:9)

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18

Card 2

APPROVED FOR RELEASE: 08/31/2001 CIA-RDP86-00513R001757720002-0"

L 25205-65

SOV/78-4-8-37/43

5(2)

AUTHORS: Savitskiy, Ye. M., Tylkina, M. A., Povarova, K. B.

TITLE: The Phase Diagram of the System Chromium - Rhenium (Diagramma sostoyaniya sistemy khrom - reniy)

PERIODICAL: Zhurnal neorganicheskoy khimii, 1959, Vol 4, Nr 8, pp 1928-1930 (USSR)

ABSTRACT: By means of various physico-chemical methods (determination of the melting point, microscopic analysis, X-ray analysis, measurements of hardness and microhardness), the phase diagram chromium-rhenium was determined (Fig 1). Some microstructures of cast or thermally processed alloys are shown in figure 2. The phase diagram shows a peritectic type. The peritectics are between 2350° (liquid phase + β ⇄ σ) and 2280° (liquid phase + σ ⇄ α (the solid α-solution is formed on Cr-basis, the solid solution on Rh-basis)). The hardness of the solid solution increases with the rhenium content (138 kg/mm² for pure Cr, 322 kg/mm² for the alloy with 63.5 % by weight Rh). The one-phase range of the solid solution of chromium and rhenium was approximately outlined. Apparently the solubility of chromium

Card 1/2

in rhenium does not exceed 5 % by weight Cr. It is emphasized that an addition of 40% rhenium to chromium improves the plasticity of chromium and its processing is facilitated by cutting. There are 2 figures and 8 references, 4 of which are Soviet.

SUBMITTED: March 17, 1959

5(2) SOV/78-4-10-23/40

AUTHORS: Tylkina, M. A., Pekarev, A. I., Savitskiy, Ye. M.

TITLE: Phase Diagram of the System Titanium - Hafnium

PERIODICAL: Zhurnal neorganicheskoy khimii, 1959, Vol 4, Nr 10, pp 2320 - 2322 (USSR)

ABSTRACT: According to data obtained by means of different methods the phase diagram Ti - Hf was constructed (Fig 1a). As it was to be expected according to the analogous structure of the electron shell of these elements, they form a continuous series of solid α- and β-solutions which are separated by a diphase α+β-region. The curves of the changes of physical properties of the melts with variable composition (Fig 1b) confirm this phase diagram. Figure 2 shows the microstructure of titanium - hafnium alloys treated in a different way. There are 2 figures and 6 references, 3 of which are Soviet.

ASSOCIATION: Institut metallurgii im. A. A. Baykova Akademii nauk SSSR (Institute of Metallurgy imeni A. A. Baykov of the Academy of Sciences, USSR)

SUBMITTED: May 4, 1959

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SOV/89-7-3-5/29

18(6), 21(1)

AUTHORS: Savitskiy, Ye. M., Tylkina, M. A., Tsyganova, I. A.

TITLE: The Phase Diagram of the System Zirconium - Rhenium

PERIODICAL: Atomnaya energiya, 1959, Vol 7, Nr 3, pp 231-235 (USSR)

ABSTRACT: By means of the well-known radiographical and microscopical methods the melting point, the hardness, and the microhardness of the phases were measured. On the basis of these data the phase diagram of the zirconium - rhenium system was set up. In α-zirconium the range of the solid solution of rhenium amounts to ~0.5 % by weight at 800°C. At the eutectic transformation temperature the percentage increases to 2-3 % by weight. In β-zirconium at 1600°C 14.68 % by weight of rhenium and at the eutectic point of transformation at 500-600°C only 8 % by weight are dissolved. In alloys containing more than 4 % by weight of rhenium, a stable β-phase is found. At 1600°C and 25 % by weight of rhenium a eutectic forms. In alloys with a high zirconium content a metastable ω-phase was found to exist. The solubility of zirconium in rhenium at 2500°C is less than 2 % by weight. Three chemical compounds are produced in the system by peritectic reactions: 1) At 2500°C: Zr_5Re_{24} of the α-Mn-type

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The Phase Diagram of the System Zirconium - Rhenium SOV/89-7-3-5/29

with volume-centered cubic lattice (a = 9.6 - 9.7 kX). Microhardness amounts to 1000 kg/mm^2. 2) At 2450°C: $ZrRe_2$ with hexagonal tightly bound lattice (a - 5.21 - 5.25 Å; c = 8.5 - 8.56 Å; c/a = 1.63). Microhardness 1200 kg/mm^2. 3) At 1900°C: Zr_2Re σ-phase type with tetragonal lattice (a = 10.12 Å; c = 5.42 Å; c/a = 0.535). Microhardness 700 - 800 kg/mm^2. The phase diagram and microhardness are shown graphically. Photographs are available for some of the ground sections. The radiographic investigations were carried out by P. I. Kripyakevich and Ye. I. Gladyshevskiy at the LGU. There are 7 figures, 1 table, and 8 references, 4 of which are Soviet.

SUBMITTED: April 16, 1959

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24(2) SOV/20-127-2-21/70

AUTHORS: Tylkina, M. A., Kirilenko, R. F., Savitskiy, Ye. M.

TITLE: The Diagram of Recrystallization of Hafnium

PERIODICAL: Doklady Akademii nauk SSSR, 1959, Vol 127, Nr 2, pp 310-312 (USSR)

ABSTRACT: It is the object of the present study to determine some of the properties of hafnium and to investigate recrystallization- and deformation-processes. From metallographic and X-ray analyses, as well as by determining hardness, the authors derived the recrystallization diagram shown in figure 1. Hafnium is a dimorphous metal, the hexagonal α-modification changing into the cubic body-centered β-modification at higher temperatures. Hafnium iodide bars of coarse structure were used as original material. The physical properties of these Hafnium iodide bars are given together with a description of the elimination of the coarse structure. The deformation was carried out in eight steps from ranging 5% to the maximally tolerable deformation of 60%. Vacuum-annealing was performed in seven stages between 750 and 1550° C. Recrystallization set in at 1000° C after 10%

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deformation, at 850° C after 20% deformation, and at 750° C after 40% or more deformation. Annealings within the temperature range of the α-modification yield a fine-grained polyeder structure with grain sizes of between 25 and 40 μ after 30% to 45% deformation. Annealings above the temperature of the polymorphous transition gives a coarser grain (240 μ) and a marked structural change. The similarity of the deformation- and recrystallization properties between hafnium, titanium and zirconium is pointed out. Also, their α - and β-modifications are compared and their high plasticity stressed. By their hardness and cold workability they are arranged in the following order: titanium - zirconium - hafnium. It follows from the recrystallization diagrams of the three metals that they also have similar grain sizes. Finally, the temperature stability of these metals and their alloys is emphasized. There are 3 figures and 11 references, 6 of which are Soviet.

ASSOCIATION: Institut metallurgii im. A. A. Baykova Akademii nauk SSSR (Institute for Metallurgy imeni A. A. Baykov of the Academy of Sciences, USSR)

PRESENTED: March 26, 1959, by I. P. Bardin, Academician

SUBMITTED: March 25, 1959

SAVITSKIY, Ye. M. AND TYLKINA, M.A.

* "CERTAIN PHYSICAL PROPERTIES OF RHENIUM AND ITS ALLOYS"

"RHENIUM AND TRANSITION METALS PHASE DIAGRAMS."

reports presented at the 117th Meeting of the Electrochemical Society, Chicago, Ill. 1-5 May 1960

* Studies have been made of recrystallization of rehenium, and of alloying with tungsten nickel (in Ni - Cr allovs), and with titanium and its allovs. Rhenium additions improve both room and elevated temperatures. solid solutions solid solution tungsten allovs have increased workabilitv and electrical resistance Applications for rehenium alloys are promising for thermocouples,electrical contacts and some vacum tube parts. results are given of a studv of rhenium as a contact material.

KRIPYAKEVICH, P.I.; TYLKINA, M.A.; SAVITSKIY, Ye.M.

New compound in the rhenium-zirconium system and its crystal structure. Izv. vys. ucheb. zav.; chern. met. no.1:12-15 '60.

1.L'vovskiy gosudarstvennyy universitet i Institut metallurgii AN SSSR. (Rhenium-zirconium alloys--Metallography)

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B011/B005

AUTHORS: Tylkina, M. A., Povarova, K. B., Savitskiy, Ye. M.

TITLE: The Sigma Phase in the Rhenium-Vanadium System

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol 131, Nr 2, pp 332-334 (USSR)

ABSTRACT: In their previous paper, the authors established the phase diagram of the vanadium-rhenium system (Ref 10). In the present paper, they wanted to determine the temperature range of the existence of the σ-phase. For this purpose, they annealed casting alloys at high temperature (1750° for 7 h, 1500° for 5 h, 1000° for 450 h). The X-ray investigation was carried out in a chamber of type PKD with CrK_{α}-radiation. The X-ray structural and microstructural investigations showed the eutectoid decomposition of the σ-phase at 1500°. 2 solid solutions are formed: on the basis of vanadium (α) and rhenium (Fig 1 a,b). The roentgenogram of a casting alloy shows a system of lines characteristic of σ-phases (Table 1). The lattice parameters were computed as follows: a = 9.39 Å, c = 4.86 Å, c/a = 0.52. Table 1 lists comparative data of roentgenographic calculations of σ-phases in rhenium systems with zirconium, vanadium, niobium, tantalum, chromium, molybdenum, wolfram, manganese, and iron (Refs 4-9). A certain phase difference in the system

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The Sigma Phase in the Rhenium-Vanadium System

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Zr-Re is striking; the authors assigned this phase to a type related to the σ-phases. This difference may be explained by the fact that the metals of the 4th side group usually do not form σ-phases. The appearance of the σ-phase in the system Zr-Re might be considered to be an exception. Moreover, the formation of σ-phases in the rhenium system with manganese and iron (Ref 8) is worth noticing. This suggests an anomalous behavior of rhenium as compared with metals of other groups. There are 1 figure, 1 table, and 10 references, 8 of which are Soviet.

ASSOCIATION: Institut metallurgii im. A. A. Baykova Akademii nauk SSSR (Institute of Metallurgy imeni A. A. Baykov of the Academy of Sciences, USSR)

PRESENTED: December 2, 1959, by I. P. Bardin, Academician

SUBMITTED: December 1, 1959

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E032/E314

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AUTHORS: Gladyshevskiy, Ye.I., Tylkina, M.A. and Savitskiy, Ye.M.

TITLE: X-ray and Microscopic Study of Hf-Re Alloys

PERIODICAL: Kristallografiya, 1960, Vol. 5, No. 6, pp. 877 - 881

TEXT: A study is reported of phase equilibria in alloys of rhenium and hafnium containing 66% of Hf by weight. The existence of four compounds has been established and the crystal structure of two of them has been determined (Hf_5Re_{24}, structural type: Ti_5Re_{24}, a = 9.713 ± 0.005 Å; $HfRe_2$, structural type: $MgZn_2$, a = 5.248 ± 0.001 Å, c = 8.592 ± 0.002 Å, c/a = 1.637 . The compound He_5Re_{24} (microhardness measured with a load of 100 g to an accuracy of 40 kg/mm^2 was H_μ = 1130 kg/mm^2) in cast specimens is

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X-ray and Microscopic Study of Hf-Re Alloys

found to be in equilibrium with rhenium (H_{μ} = 760 kg/mm^2). X-ray data for annealed alloys with a large concentration of rhenium indicate the presence of a phase "A" of unknown composition of structure. The microhardness of $HfRe_2$ was found to be 1 460 kg/mm^2. In cast alloys containing 33 and 50 at.% Re in equilibrium with the solid solution based on the cubic body-centred modification of hafnium (β-Hf), a further phase of unknown structure (B) was detected. The latter phase is probably Hf_2Re and its microhardness is 1980 kg/mm^2. Table 1 gives the phase composition of the HfRe alloys:

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X-ray and Microscopic Study of Hf-Re Alloys

Concentration of rhenium, % by wt.	Concentration of rhenium, at. %	Microhardness (cast alloys)	Phase Composition of alloys: Cast	Phase Composition of alloys: Annealed at 1000 °C for 150 hrs
99	99.0	Heterogeneous	Re+trace Hf_5Re_{24}	Re+A
97	96.8	"	$Re+Hf_5Re_{24}$	A+Re
93	92.7	"	$Hf_5Re_{24}+Re$	A
83.5	82.9	Homogeneous, trace 2nd phase	Hf_5Re_{24}	Hf_5Re_{24}
67.5	66.6	-ditto-	$HfRe_2$	$HfRe_2$
51.3	50.2	Heterogeneous	β-Hf+B	B+trace α-Hf
34.0	33.1	"	β-Hf+trace B	α-Hf+trace B

Table 2 gives the lattice constants of the two modifications of hafnium and $HfRe_{24}$ and $HfRe_2$

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X-ray and Microscopic Study of Hf-Re Alloys

No. of alloy and heat treatmt.	Phase	Lattice constants A a	c	c/a
4. Annealed at 1000 °C	Hf_5Re_{24}	9.713±0.005	-	-
5. -do-	$HfRe_2$	5.248±0.001	8.592±0.002	1.637
6. -do-	α-Hf	3.20 ± 0.01	5.08 ± 0.01	1.58
7. Cast	β-Hf	3.50 ± 0.01	-	-

Table 4 gives the interatomic distances in $HfRe_{24}$:

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X-ray and Microscopic Study of Hf-Re Alloys

	Hf (a)	Hf (c)	Re (g_1)	Re (g_2)	Coordination No. (total)
Hf (a)	-	3.08 (4)	-	2.95 (12)	16
Hf (c)	3.08 (1)	-	2.71 (3) 3.21 (3)	2.93 (6) 3.15 (3)	16
Re (g_1)		2.71 (1) 3.21 (1)	2.91 (6)	2.67 (1) 2.73 (2) 2.90 (2)	13
Re (g_2)	2.95 (1)	2.93 (2) 3.15 (1)	2.67 (1) 2.73 (2) 2.90 (2)	2.44 (1) 2.61 (2)	12

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X-ray and Microscopic Study of Hf-Re Alloys

The numbers in brackets in the above table refer to the coordination numbers. Table 6 gives the interatomic distances in $HfRe_2$.

	Hf	$Re^{(1)}$	$Re^{(2)}$	Coordination No. (total)
Hf	3.22 (3) 3.23 (1)	3.07_6 (3)	3.07_8 (3) 3.08_3 (6)	16
$Re^{(1)}$	3.07_6 (6)	-	2.62_8 (6)	12
$Re^{(2)}$	3.07_8 (2) 3.08_3 (4)	2.62_8 (2)	2.62_3 (4)	12

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E032/E314

X-ray and Microscopic Study of Hf-Re Alloys

There are 6 tables and 9 references: 2 Soviet and 7 non-Soviet.

ASSOCIATION: L'vovskiy gosudarstvennyy universitet imeni I. Franko (L'vov State University imeni I. Franko)
Institut metallurgii imeni A.A. Baykova AN SSSR (Institute of Metallurgy imeni A.A. Baykov, AS USSR)

SUBMITTED: February 29, 1960 (initially)
June 2, 1960 (after revision)

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B015/B060

AUTHORS: Tylkina, M. A., Povarova, K. B., Savitskiy, Ye. M.

TITLE: Ternary Solid Solutions in the Tungsten - Molybdenum - Rhenium System

PERIODICAL: Zhurnal neorganicheskoy khimii, 1960, Vol. 5, No. 11, pp. 2458-2461

TEXT: The article under consideration shows a part of the constitution diagram of the W - Mo - Re ternary system obtained by the method of microstructural analysis, by measuring the hardness and the melting point of the alloys. The authors studied the diagram on the side of the solid solution in tungsten and molybdenum up to 50 wt% rhenium, with the alloys of the parallel cross sections W - Mo being selected with a constant rhenium content of 10, 20, 30, 40, and 50% (Fig. 1). From the data of phase analysis, three isothermal cross sections of cast alloys, annealed at 1750°C for 3 h, and at 1000°C for 450 h were recorded. The cuts for the microstructural examinations were etched in a mixture of 10% KOH and 30% $K_3[Fe(CN)_6]$ (1 : 2). A fairly large region of ternary solid solutions

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Ternary Solid Solutions in the Tungsten - Molybdenum - Rhenium System

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with body-centered cubic crystal lattice was observed in the system concerned. A ternary σ-phase formed. Between the ternary solid α-solutions and the σ-phase there is the two-phase region $\alpha+\sigma$ (Fig. 1). It may be observed from the pictures of microstructure (Fig. 2) of the cross section with 40 wt% Re that the alloy with 40 wt% W and 20 wt% Mo is situated at the limit of solubility and is a one-phase ternary solid solution at high temperatures, which on a decrease of temperature passes over into the two-phase state $\alpha+\sigma$. The alloy with 30 wt% W and 30 wt% Mo remains a one-phase ternary solid solution at all temperatures. The alloy 50 wt% W and 10 wt% Mo, on the other hand, has a two-phase structure $\alpha+\sigma$ at all temperatures. The formation of twins, which had already been observed by Highes and Geach (Ref. 5), C.T. Sims and R. J. Jaffee (Ref. 6) was identified in the region of ternary solid solutions. This additional deformation by twinning is explained by the larger amount (in this field) of the densely packed hexagonal rhenium. For this reason, high elasticity and good mechanical properties are expected of alloys of this region. In the region of ternary solid solutions hardness changes little with temperature (Table). Changes in the solidus temperature showed that in the region of ternary solid solutions at constant rhenium content (up to

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Ternary Solid Solutions in the Tungsten - Molybdenum - Rhenium System

30 wt% Re) there occurs a uniform drop of the melting point of alloys with a decrease of the tungsten content and an increase of the molybdenum content. In the authors' opinion, the alloys of the composition of ternary solid solutions are specially suited as building material, wherever great demands are made on strength, plasticity, weldability, and a high melting point, but no stability to oxidation at high temperatures. There are 2 figures, 1 table, and 8 references: 4 Soviet, 3 German, and 1 US.

ASSOCIATION: Institut metallurgii im. A. A. Baykova Akademii nauk SSSR (Institute of Metallurgy imeni A. A. Baykov of the Academy of Sciences of the USSR)

SUBMITTED: February 17, 1960

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TYLKINA, M. A. and SAVITSKIY, Ye. M.

"Certain Physical Properties of Rhenium and its Alloys."

"Rhenium and Transition Metals Phase Diagrams."

E. M. Savitski and M. A. Tylkina, Institute of Metallurgy, Academy of Sciences of the U.S.S.R., Moscow, U.S.S.R.

Binary phase diagrams of rhenium with titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten, manganese, and cobalt have been determined. A number of these alloy systems are characterized by the formation of inter-metallic phases of the sigma or alpha-manganese types. Comparisons are made of these and other common features of the respective diagrams on the basis of the periodicity of the binary alloy additions.

Report presented at the 117th Meeting of the Electrochemical Society, Chicago, 1-5 May 1960.